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BY CHESTER STOCK

WITH FOUR PLATES AND ONE TEXT-FIGURE

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Contribution No. 21

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Among the canid remains obtained by University of California collecting parties in the upper portion of the Ricardo beds of the Mohave Desert were several specimens provisionally referred by Merriam [1] to the genus *Ælurodon*. A maxillary fragment with posterior cheek-teeth, No. 21507 U. C. Coll., furnished the type of the species *Ælurodon? aphobus* Merriam. A second specimen, a mandibular ramus, No. 22470 U. C. Coll., with well-worn teeth was regarded by Merriam as possibly belonging to *Æ.? aphobus*, this relationship being suggested by the size and proportion of the teeth in the latter form.

Since publication of Merriam's report on the Ricardo fauna there has appeared Matthew's third contribution to the Snake Creek fauna. In this report Matthew [2] refers to the *Ælurodon* specimens described from the Ricardo, regards *Ælurodon aphobus* as closely related to *Æ. haydeni validus* from the Snake Creek, and suggests further that the Ricardo type may be a subspecies of *Æ. haydeni*.

Later collecting in the Ricardo deposits has brought to light little additional material belonging to *Ælurodon*. A fragmentary mandibular ramus of this form, likewise from the upper Ricardo beds in the vicinity of Red Rock Cañon, was obtained by Mr. J. W. Lytle of the Los Angeles Museum. The specimen, No. 6 L. A. Mus. Coll. (Plate I, fig. A), fortunately preserves the canine, $P\frac{2}{2}$ to $M\frac{2}{2}$, in a moderate state of wear. The alveoli for $P\frac{1}{1}$ and $M\frac{3}{3}$ are also shown in this specimen. No. 6 furnishes therefore a satisfactory basis for comparing the Ricardo type with *Ælurodon* species of the Great Plains region, particularly with those forms known by mandibular fragments. A more detailed comparison is now also permitted between the lower jaw material from the Ricardo and the type of *Ælurodon aphobus* than is possible from the specimens available in the University collections.

In No. 6 the crown of the lower canine is relatively small and slender. The premolars are situated close together in fore and aft line. The alveolus for $P\frac{1}{1}$ shows that this tooth was single-rooted. $P\frac{2}{2}$ is two-rooted, with the roots fused. $P\frac{2}{2}$ and $P\frac{3}{3}$ have simple, single-cusped crowns. $P\frac{4}{4}$ has the characteristic shape and position seen in *Ælurodon*. The posterior border truncates the tooth obliquely. In $M\frac{1}{1}$ the metaconid is low and quite distinct from the protoconid. The hypo-

[1] J. C. Merriam, Univ. Calif. Publ. Bull. Dept. Geol., vol. 11, pp. 535–542, 1919.
[2] W. D. Matthew, Bull. Amer. Mus. Nat. Hist., vol. 50, p. 100, 1924.

conid and entoconid are both well-developed cusps. In $M\bar{2}$ the two roots are widely divergent, a character noted by Leidy in *Ælurodon haydeni*. The worn occlusal surface shows clearly the arrangement of the cusps. A well-developed paraconid ridge extends inward from the large protoconid. The entoconid region is reduced, relatively more so than in *Canis*. The alveolus for $M\bar{3}$ indicates that the tooth possessed two roots which were fused.

Specimen No. 6 agrees closely in size and shape with the mandibular fragment, No. 22470 U. C. C., from the Ricardo, which has been regarded as possibly belonging to *Æ. aphobus*. A study of the lower dentition in No. 6 L. A. Mus. Coll. and of the teeth in the type of *Æ. aphobus* suggests quite strongly that the former specimen represents the same species to which the maxillary fragment has been assigned. In $M\bar{1}$ the paraconid-protoconid blade corresponds in length with the paracone-metacone blade of $P\underline{4}$ in No. 21507. When oriented in this position of shear, the hypoconid occludes with the protocone of $M\underline{1}$ and the entoconid apparently strikes the crown of this tooth between the protocone and the hypocone lobe. The paraconid and protoconid of $M\bar{2}$ occlude with the crown of $M\underline{1}$, in which respect *Ælurodon* differs from *Canis*.

As indicated by Matthew, *Æ. aphobus* is closely related to the Great Plains species *Æ. haydeni*. No. 6 agrees closely in size and shape with the type of *Æ. haydeni*. In the Ricardo specimen $M\bar{1}$ is slightly longer than that of Leidy's type, but $P\bar{3}$ is distinctly shorter. In $P\bar{4}$ of *Æ. haydeni* as shown by Leidy,[3] a slight but distinct cingulum extends along the outer side of the base of the crown above the posterior root. In the illustration of $P\bar{3}$ a similar development of the cingulum is suggested. A cingulum is only faintly indicated at the posterior end of the outer surface of $P\bar{4}$ and is entirely absent in $P\bar{3}$ of the specimen from Ricardo. Leidy states that in the Great Plains species the roots of $M\bar{3}$ are well separated. In No. 6 the roots of this tooth were evidently fused. The posterior root-socket of $M\bar{2}$ is elevated more along the side of the ascending portion of the ramus in Leidy's type than in the Ricardo form.

With the subspecies *Æ. haydeni validus* described by Matthew and Cook from the Snake Creek the Ricardo specimen again compares quite closely. The principal differences between the two forms seem to lie in a less transverse position of $P\bar{3}$ and in a greater depth of ramus below the anterior premolars in the Ricardo specimen. Matthew and Cook state that the canine alveolus in their specimen indicates a large and massive tooth. The lower canine is certainly not a large tooth in No. 6.

Records of the occurrence of *Ælurodon* in the Ricardo suggest the presence of this genus, particularly in the upper portion of the deposit.

[3] J. Leidy, *The extinct mammalian fauna of Dakota and Nebraska, etc.*, Journ. Acad. Nat. Sci. Phila., ser. 2, vol. 7, pl. 1, fig. 10, 1869.

In this connection it is interesting to note that the amphicyonine dog *Hadrocyon* is known from a locality distinctly lower in the Ricardo. While the occurrences of these canid forms may be fortuitous, their distribution on the other hand may be indicative of a faunal difference between the upper and lower portions of the Ricardo section.

Measurements (in millimeters) of No. 6 L. A. Mus. Coll.

Lower canine, anteroposterior diameter at base of enamel	15.1
Lower canine, transverse diameter at base of enamel	12.8
$P\frac{2}{2}$, anteroposterior diameter	9.8
$P\frac{2}{2}$, transverse diameter	7.2
$P\frac{3}{3}$, anteroposterior diameter	12.8
$P\frac{3}{3}$, transverse diameter	8.3
$P\frac{4}{4}$, anteroposterior diameter	20.1
$P\frac{4}{4}$, transverse diameter	12.
$M\frac{1}{1}$, anteroposterior diameter	35.5
$M\frac{1}{1}$, transverse diameter across heel	13.5
$M\frac{2}{2}$, anteroposterior diameter	16.
$M\frac{2}{2}$, transverse diameter	10.6
Length from anterior end of C to posterior alveolar border of $M\frac{3}{3}$	130.
Length from anterior alveolar border of $P\frac{1}{1}$ to posterior alveolar border of $M\frac{3}{3}$	106.6
Length from anterior end of $P\frac{3}{3}$ to posterior alveolar border of $M\frac{3}{3}$	90.4
Depth of ramus measured between $P\frac{2}{2}$ and $P\frac{3}{3}$ (approximate)	34.4

The fragmentary nature of the proboscidean remains heretofore secured from the Ricardo has permitted only a tentative determination of the mastodons occurring in the Ricardo fauna. Materials recently secured in these deposits by the Los Angeles Museum afford further opportunity to reach a determination of the generic type represented, and furnish moreover some information concerning a few skeletal elements of these forms.

The collection includes a fragmentary skull (Plate 1, figs. B and C), an incomplete mandibular ramus (text-fig. 1) and humerus, a femur and a calcaneum (Plates 2 and 3). The materials were found at three distinct localities in the Ricardo deposits.

Trilophodon sp.

The skull, shown in Plate 1, was found near Iron Cañon in section 26, T. 29 S., R. 37 E., Mount Diablo B. and M. and prepared by J. W. Lytle. In this specimen (No. 1 L. A. Mus. Coll.) the palatal portion of the skull is preserved. The dentition includes the second and third molars. The two tusks are also present, although not completely preserved. No. 1 represents an individual approximating in size *Trilophodon productus*.

In ventral view the tusks are seen to diverge in their outward extent. They are likewise deflected downward as seen in side view. Remnants of enamel are to be seen on the tusks, the enamel extending along the surface for perhaps two-thirds the distance from tip to alveolar border. Near the tip of the right tusk the round-oval cross-section has been somewhat modified through attrition.

$M\frac{2}{2}$ is greatly worn, but the crown of the tooth appears quite certainly to have possessed three transverse crests.

$M\frac{3}{3}$ (Plate 1, fig. D) has three well-defined anterior crests which are followed posteriorly by two smaller crests. Not all of the tooth has undergone

wear, for only the first crest is sufficiently worn to show a considerable area of dentine. The summit of the second ridge, particularly that portion of it formed by the inner cusp, is slightly worn. The first three transverse ridges are distinctly separated along the median line of the tooth into outer and inner cusps. In the first two crests these cusps are of nearly equal size. In the third the inner cusp is distinctly larger than the outer. A buttress is present at the antero-external side of the inner cusp of the first crest and extends forward to the middle of the anterior end of the tooth.

The valley between the first and second transverse crests and that between the second and third are open toward the outer side, but on the lingual side of the median line they are intercepted by buttresses formed on the anterior and posterior faces of the inner cusp of the second crest. The two crests lying posterior to the third transverse ridge are each made up of three tubercles.

A well-defined crenulated basal ridge or cingulum extends along the inner side of the tooth from a point in front of the inner cusp of the first crest to a point behind the third crest. The cingulum is apparent on the outer side between the transverse ridges and is well developed behind the outer cusp of the first crest where a small tubercle is formed.

In possessing a relatively simple type of crest development $M\underline{3}$ in No. 1 L. A. Mus. Coll. exhibits a character noted by Merriam for the last lower tooth in a mandibular fragment, No. 22681 U. C. Coll. from the Ricardo. The tooth in the latter form is approximately 150 mm. long, thus being slightly shorter than $M\underline{3}$ of the Los Angeles Museum specimen. The teeth have a similar number of cross-crests.

$M\underline{3}$ in the specimen from the Ricardo shows some resemblance to the comparable tooth of trilophodont mastodons recently described by Frick[4] from the Santa Fé beds of New Mexico. A last upper molar tentatively referred by Frick[5] to *Trilophodon productus* is smaller than the Ricardo tooth, but agrees with the latter in the comparative simplicity of the crown. In this tooth the tubercles of the last crest are not so well developed as in the Los Angeles Museum form.

Trilophodon pojoaquensis Frick is a larger type, in which $M\underline{3}$ possesses a greater number of accessory tubercles than in the Ricardo species. Furthermore, the Ricardo mastodon differs in having straighter tusks as seen in side view, and the palate in front of the second molars is not extended as much as in the species from the Santa Fé beds.

The characters seen in the Ricardo species indicate apparently a form not far removed in stage of development from the trilophodont mastodons of the late Miocene.

Measurements (in millimeters) of skull, No. 1, L. A. Mus. Coll.

Length measured along median line from anterior end of palate to a point opposite posterior margin of $M\underline{3}$ (approximate)	425.
Distance between inner borders of superior tusks immediately in front of alveolar borders	96.
Greatest transverse diameter of left tusk immediately in front of alveolar border	81.6
Greatest transverse diameter of left tusk, taken 200 mm. in advance of point where preceding measurement was taken	72.8
Least distance between inner anterior borders of second superior molars (approximate)	74.4
Length measured from anterior end of $M\underline{2}$ to posterior end of $M\underline{3}$ (approximate)	265.
$M\underline{2}$, greatest anteroposterior diameter (approximate)	100.7
$M\underline{2}$, greatest transverse diameter through middle of tooth	67.
$M\underline{3}$, greatest anteroposterior diameter	172.7
$M\underline{3}$, transverse diameter across first crest (approximate)	71.
$M\underline{3}$, transverse diameter across third crest	69.5
$M\underline{3}$, height of outer cusp of third crest measured from bottom of second valley to summit	50.7

[4] C. Frick, Bull. Amer. Mus. Nat. Hist., vol. 56, pp. 122–178, 1926.
[5] C. Frick, *op. cit.*, p. 144, fig. 22c, 1926.

Trilophodon? sp.

An incomplete lower jaw, humerus and femur of a mastodon, possibly the genus *Trilophodon*, were collected at Los Angeles Museum Locality 1001 in the Ricardo deposits of Last Chance Cañon. The specimens, found by Howard R. Hill, came from a stratigraphic horizon not far below that containing the petrified trees located in section 8, T. 29 S., R. 30 E., Mount Diablo B. and M.

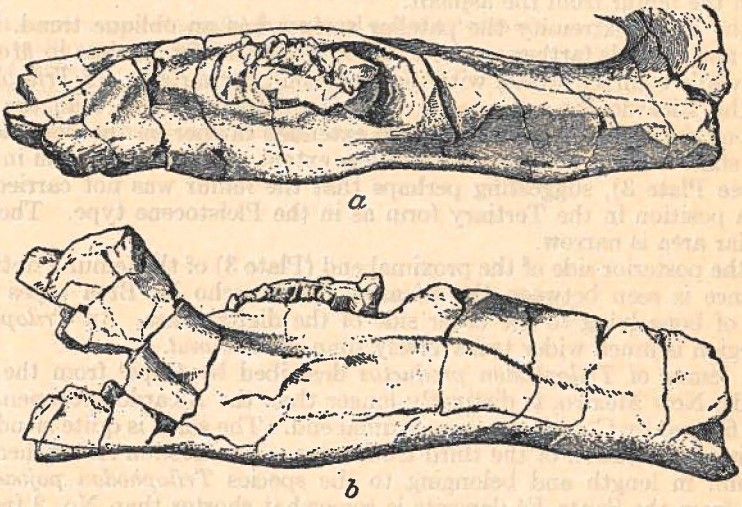


Fig. 1. *Trilophodon?* sp. Ramus of mandible, No. 4, L. A. Mus. Coll.; *a*, superior view; *b*, lateral view; ×0.166. Ricardo deposits, Mohave Desert, California.

The right ramus of the mandible, No. 4 L. A. Mus. Coll., is shown in text-figure 1. Unfortunately, the single tooth, apparently $M\overline{3}$, remaining in the jaw is badly damaged. The front end of the jaw is also broken away. No. 4 appears to resemble in size No. 22681 U. C. Coll., a portion of a mandible described by Merriam from the Ricardo. No. 4 differs from the latter in the outline of the lower border of the ramus. The horizontal ramus in front of the lower dentition is deflected downward and the posterior end of the symphysis is well in advance of the tooth row. The position of the posterior border of the symphysis is farther forward than in the jaws of *Trilophodon* from the Santa Fé beds. A large cavity is present at the front end of the jaw, but whether or not this was occupied by a large tusk can not be satisfactorily determined.

The humerus accompanying the jaw is greatly crushed and poorly preserved. The distal end is shown in Plate 2 (fig. A), where it is compared with the comparable portion of the humerus (fig. B) of the Pleistocene mastodon from Rancho La Brea. The outer tuberosity does not appear to be as well developed in the Ricardo form as in the Rancho La Brea species. The distal articulating surface is larger than in the Pleistocene humerus and differs also in having an oblique position.

The femur (Plates 2 and 3), although somewhat crushed on the posterior side, is nearly completely preserved and belongs to an adult individual. No. 2 is longer than a femur of the Pleistocene mastodon of Rancho La Brea

in the Los Angeles Museum collection, but is shorter than that of the Warren mastodon (*Mammut americanus*). The Ricardo specimen exceeds in transverse width of proximal end the Pleistocene femur from Rancho La Brea, while the middle portion of the shaft is more slender. The head extends farther above the plane of the surface of the great trochanter and the articulating surface is directed more inward, less upward, than in the Pleistocene form. The lesser trochanter is situated higher on the inner side of the shaft while the third trochanter appears to have been more prominently developed than in the femur from the asphalt.

At the distal extremity the patellar surface has an oblique trend, is narrower, and extends farther on the anterior side of the femur than in *Mammut*. It is broadly confluent below with the inner condylar surface. In *Trilophodon?* from the Ricardo the outer condyle is distinctly narrower than the inner. The condylar surfaces appear to have extended farther on the posterior side of the shaft and are therefore seen to less extent in distal view than in *Mammut* (see Plate 3), suggesting perhaps that the femur was not carried in as erect a position in the Tertiary form as in the Pleistocene type. The intercondylar area is narrow.

On the posterior side of the proximal end (Plate 3) of the femur a noticeable difference is seen between the Ricardo and Rancho La Brea types in the width of bone lying to the outer side of the digital fossa. In *Trilophodon?* this region is much wider transversely than in *Mammut*.

The femur of *Trilophodon productus* described by Cope[6] from the Santa Fé beds, New Mexico, is distinctly longer than the Ricardo specimen. The femur figured by Cope lacks the proximal end. The shaft is quite slender and there is no indication of the third trochanter. A mastodon femur measuring 810 mm. in length and belonging to the species *Trilophodon pojoaquensis* Frick[7] from the Santa Fé deposits is somewhat shorter than No. 2 from the Ricardo.

A calcaneum, No. 5 L. A. Mus. Coll., was found in the Ricardo deposits as exposed between Red Rock Cañon and Last Chance Cañon. Illustrations of this element and of the comparable bone in the Pleistocene mastodon of Rancho La Brea are shown in Plate 4.

No. 5 is seen to differ from the calcaneum of the Pleistocene form in the following characters:

(1) The posterior end of the tuber calcis, as viewed from the side (see Plate 4, fig. C), shows a fuller development. The process itself is relatively longer and more massive.

(2) A well-defined notch behind the tendinal groove of the outer or fibular side is absent.

(3) The anterior or dorsal surface of the tuber calcis slopes upward directly to the large astragalar facet. In other words, the articulating surface is not situated on a platform distinctly removed from or well above this surface.

(4) The forward or proximal portion of the channel between the large astragalar facet and the sustentacular facet is not deep.

(5) The principal cuboidal surface is relatively small, while that for the navicular situated on the sustentaculum is relatively large.

(6) There is a large extent of bone as seen in end view (Plate 4, fig. A), below the principal cuboidal surface.

[6] E. D. Cope, Rpt. U. S. Geog. Surv. west of the 100th Meridian. Wheeler Surv., Pt. II, vol. 4, Paleontology, p. 313, pl. 72, figs. 3, 3a, 1877.

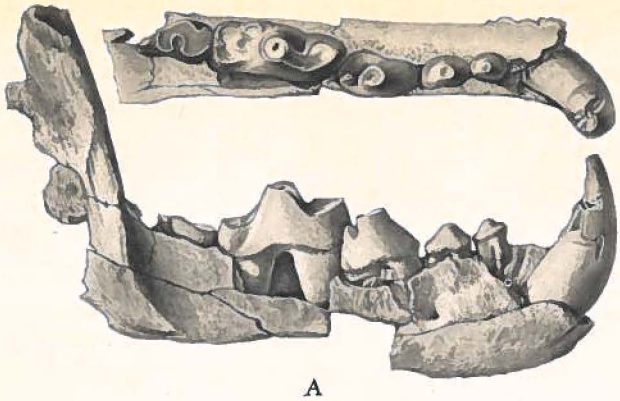
[7] C. Frick, Bull. Amer. Mus. Nat. Hist., vol. 56, pp. 161 and 165, 1926.

Measurements (in millimeters) of femur, No. 2, L. A. Mus. Coll.

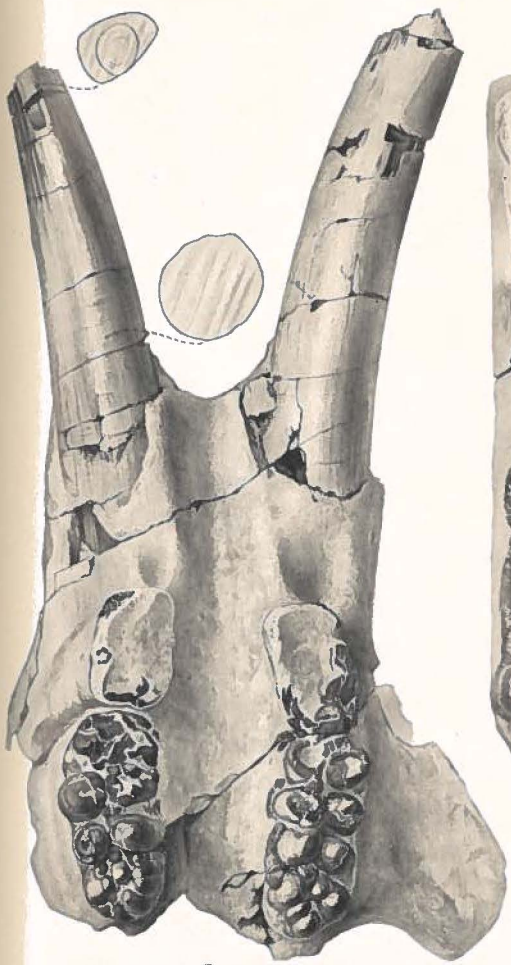
Greatest length measured from top of head to distal end of inner condyle	882.
Length measured from top of great trochanter to distal end of outer condyle	825.
Distance measured obliquely across proximal end from head to great trochanter	360.
Greatest transverse diameter of head	141.4
Least width of shaft	122.3
Greatest width of distal end	207.
Width of surface for patella	100.4

Measurements (in millimeters) of calcaneum, No. 5, L. A. Mus. Coll.

Greatest length measured parallel to principal axis of tuber calcis	186.4
Greatest width measured across astragalar facets	145.2
Width of tuberosity	84.7
Greatest diameter of the larger astragalar surface	82.3
Greatest length of the sustentacular facet	63.4
Greatest transverse diameter of cuboidal facet (approximate)	65.



A



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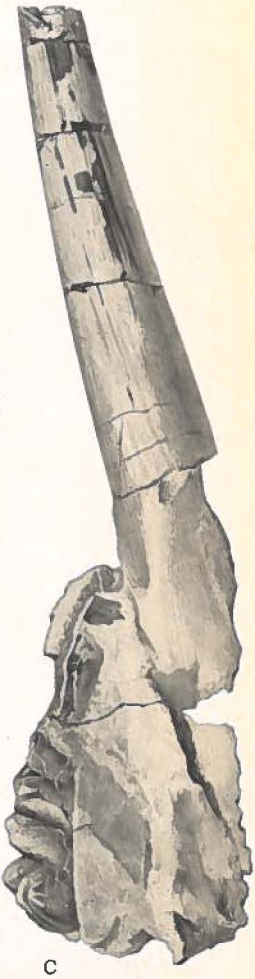


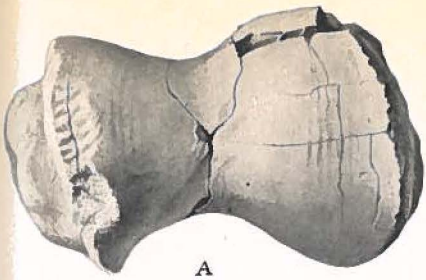
C

Fig. A. *Ælurodon aphobus* Merriam. Ramus of mandible, No. 6, L. A. Mus. Coll., lateral and superior views; ×0.50.

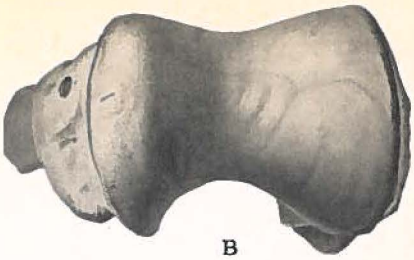
Figs. B and C. *Trilophodon* sp. Skull, No. 1, L. A. Mus. Col., inferior and lateral views; ×0.166.

Fig. D. *Trilophodon* sp. $M\underline{2}$ and $M\underline{3}$, No. 1, L. A. Mus. Coll., occlusal view; ×0.33.

Ricardo deposits, Mohave Desert, California.



A



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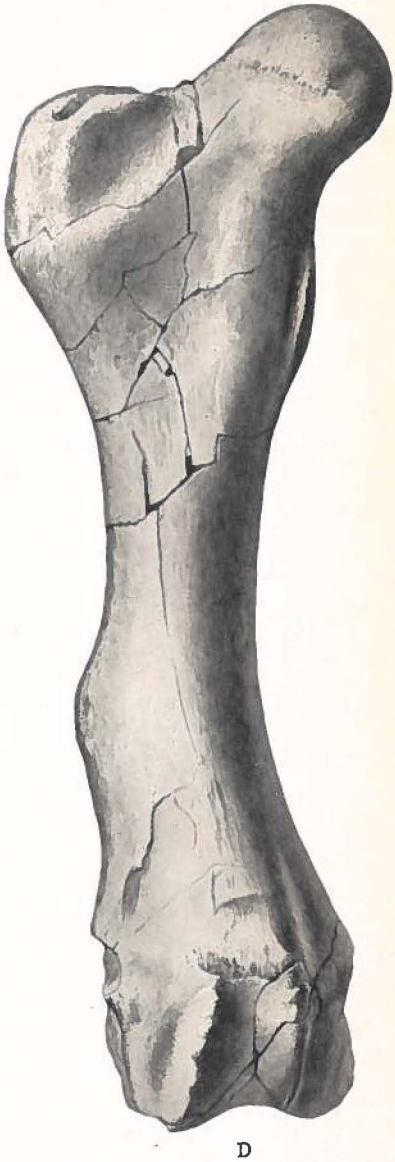

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Fig. A. *Trilophodon?* sp. Distal end of humerus. No. 3, L. A. Mus. Coll.; ×0.25. Ricardo deposits, Mohave Desert, California.

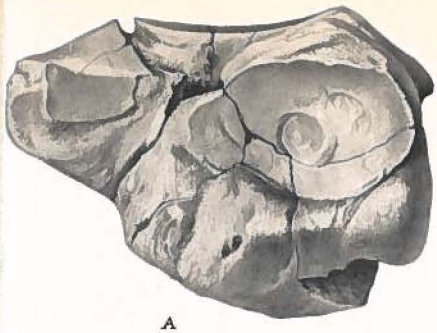
Fig. B. *Mammut americanum* (Kerr). Distal end of humerus, No. 26006, L. A. Mus. Coll.; ×0.25. Rancho La Brea Pleistocene.

Fig. C. *Mammut americanum* (Kerr). Femur, No. 26007, L. A. Mus. Coll.; anterior crest; ×0.166. Rancho La Brea Pleistocene.

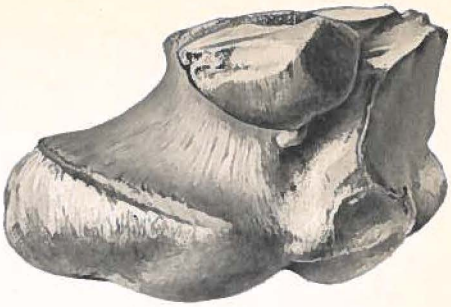
Fig. D. *Trilophodon?* sp. Femur, No. 2, L. A. Mus. Coll.; anterior view; ×0.166. Ricardo deposits, Mohave Desert, California.

Fig. A. *Mammut americanum* (Kerr). Femur, No. 26007, L. A. Mus. Coll.; posterior and distal views; ×0.166. Rancho La Brea Pleistocene.

Fig. B. *Trilophodon?* sp. Femur, No. 2, L. A. Mus. Coll., posterior and distal views; ×0.166. Ricardo deposits, Mohave Desert, California.



A



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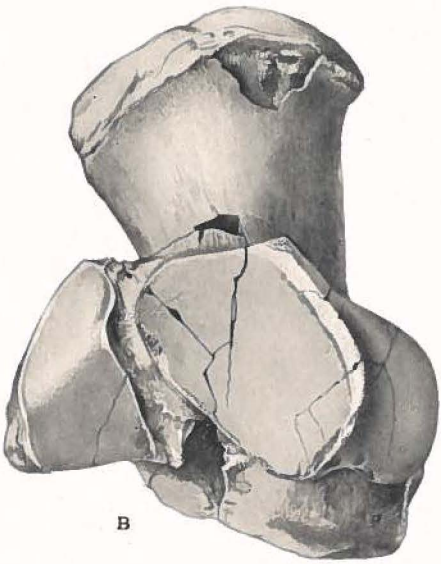

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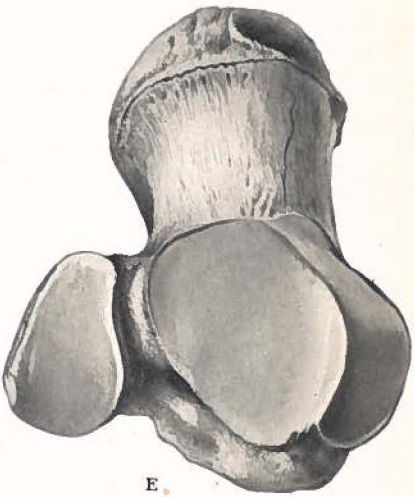

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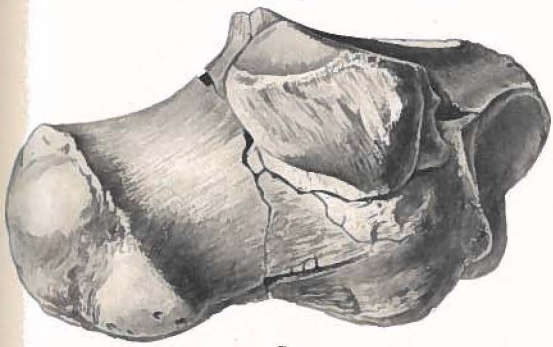

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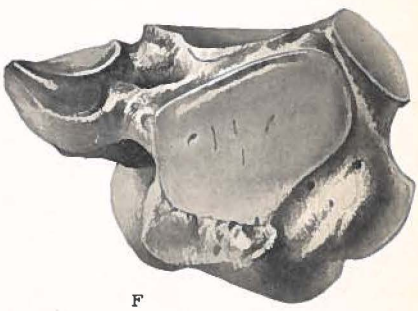

F

Figs. A, B, C. *Trilophodon?* sp. Calcaneum, No. 5, L. A. Mus. Coll.; A, distal view, B, superior view, C, inner view; ×0.40. Ricardo deposits, Mohave Desert, California.

Figs. D, E, F. *Mammut americanum* (Kerr). Calcaneum, No. 26008, L. A. Mus. Coll.; D, inner view, E, superior view, F, distal view; ×0.40. Rancho La Brea. Pleistocene.